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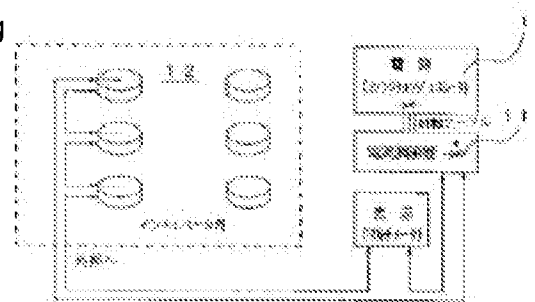
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(54) CELL CULTURE APPARATUS AND CELL CULTURE METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a cell culture apparatus and a cell culture method to enable uniform culture of cells by uniformizing electric current density.

SOLUTION: The culture apparatus is provided with a vessel 14 having a prescribed capacity and holding a lower electrode 16 at the bottom, a lid 17 put on the vessel 14 to seal the vessel, having an upper electrode 18 placed opposite to the lower electrode 16 and positioned opposite to the vessel 14 in vertical direction, a culture member 20 inserted into the vessel 14 and containing a hollow part 21 having a volume with a prescribed cross-sectional area and positioned nearly at the center, a filter 25 placed between the vessel 14 and the culture member 20, and a power source to pass electric current by applying a prescribed voltage between the lower electrode 16 and the upper electrode 18.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the cell culture device and cell culture method for culturing the cell in a culture medium.

[0002]

[Description of the Prior Art]Drawing 7 is a schematic diagram of the conventional horizontal-type cell culture device. In a figure, the current of the function generator 1 (function generator) flows into the contact button 6 of the electrode allocated in the both ends in a cell culture device via the amplifier 2 and the ammeter 3. A cell culture device sends current through the cell in culture medium by impressing voltage to the both sides of the cultivation tank 4 via the agarose 5 directly inter-electrode for pollutant removal. And the flowing current value is calculated with the oscilloscope 7. Drawing 8 is a schematic diagram of other cell culture devices. This figure is also connected to the platinum electrode 9 similarly covered with the insulating material 10 from the current source 8, and current is directly sent through a culture medium into the cell in a culture medium at a plug.

[0003]

[Problem(s) to be Solved by the Invention]The conventional cell culture device sends current through right and left, i.e., a transverse direction. For this reason, even if it made current density uniform, the galvanic stimulation to a cell had a bias under the influence of the shape of a cell, ingredient precipitate of a culture medium, etc. in the floating cell and the adsorption cell. Since culture of a cell was affected by a chemical reaction near the electrode surface, buffers, such as agarose, were made to adhere to an electrode surface. In order to change and correspond the amount of culture media to be used to an identification experiment of intracellular substances, corresponding to the kind of cell to culture, it had the fault that various culture dishes were needed.

[0004]It is in providing the cell culture device and cell culture method which were made in order that this invention might solve the conventional fault mentioned above, and the purpose can make [cell culture method] current density uniform by carrying out direction of current to the upper and lower sides (vertical mold), and can make a cell culture without variation.

[0005]

[Means for Solving the Problem]A container which has the predetermined capacity to which a cell culture device concerning Claim 1 installs a lower electrode in a pars basilaris ossis occipitalis; Cover from the

upper part of said container and said container is sealed, And a lid which is provided with an upper electrode which countered said lower electrode and was allocated, counters said container and a sliding direction, and is arranged; It is fitted in into said container, And a filter allocated between a member for culture and the; aforementioned container which are mostly provided with a centrum which has the capacity which consists of a predetermined cross sectional area in the center, and said member for culture; it has an electric power unit for impressing predetermined voltage to said lower electrode and said upper electrode, and sending current between two electrodes.

[0006]A container for culture which has the predetermined capacity to which a cell culture device concerning Claim 2 installs a lower electrode in a pars basilaris ossis occipitalis; Cover from the upper part of said container for culture, and said container is sealed, And it has an upper electrode which countered said lower electrode and was allocated, A control member which it comes to allocate by fixing to a lid and the; aforementioned container which counter said bottom container and a sliding direction and are arranged; between said container and said control member. A filter which has the allocated predetermined cross sectional area; it has an electric power unit for impressing predetermined voltage to said lower electrode and said upper electrode, and sending current between two electrodes.

[0007]A cell culture device concerning Claim 3 is a cell culture device for impressing predetermined voltage between a lower electrode and an upper electrode, sending current between two electrodes, and making a cell in a culture medium culture, A direction into which current flows is made into a sliding direction, current density in a culture medium is made uniform, and it has a current density creating means which gives uniform current density to a cell.

[0008]A cell culture device concerning Claim 4 is allocated in a hollow where said lower electrode was provided in a pars basilaris ossis occipitalis of said container.

[0009]A cell culture device concerning Claim 5 is made from platinum with spiral said upper part and lower electrode.

[0010]A cell culture device concerning Claim 6 applies agarose to the surface on which said upper part and a lower electrode counter.

[0011]A cell culture device concerning Claim 7 is characterized by said filter being a penetrable membrane film or penetrable collagen membrane.

[0012]A cell culture device concerning Claim 8 is provided with a pair of hole for said member for culture to put in tweezers for attachment and detachment.

[0013]A cell culture method concerning Claim 9 is a cell culture method for impressing predetermined voltage between a lower electrode and an upper electrode, sending current between two electrodes, and making a cell in a culture medium culture, A direction into which current flows is made into a sliding direction, current density in a culture medium is made uniform, and current density is uniformly given to a cell.

[0014]A cell culture method concerning Claim 10 is a cell culture method for impressing predetermined voltage between a lower electrode and an upper electrode, sending current between two electrodes, and making a cell in a culture medium culture, A direction into which current flows is made into a sliding direction, current density in a culture medium is made variable, and current density is changed and given to a cell.

[0015]

[Embodiment of the Invention] Hereafter, the embodiment of the cell culture device concerning this invention is explained in full detail with reference to an accompanying drawing. Drawing 1 shows the global placement figure of a cell culture device. The signal wave form by which it was generated with the function generator 1 is made into a current source via the current regulator 11, the series connection of this is carried out to the cell culture device group 12, and the current which flows into a closed circuit is measured with an ammeter, and is displayed.

[0016] Drawing 2 is a schematic diagram showing the structure of the cell culture device 13. In the cell culture device shown in the figure, the numerals 14 are containers which have the predetermined capacity of the internal hollow which carried out cylindrical shape. the container 14 -- a pars basilaris ossis occipitalis -- it has the hollow 15 in the center mostly, and the lower electrode 16 is allocated in the hollow 15. The lid 17 is put on the container 14 from the upper part. The lid 17 equips with the upper electrode 18 the position which countered the lower electrode 16. The upper part and the lower electrodes 18 and 16 are spiral, or consist of a disc-like platinum electrode. The two electrodes 18 and 16 are connected to a current source (not shown) via the contact button 19, respectively. By making an electrode spiral, the gestalt of a cell is observable from the crevice. In this way, predetermined voltage is impressed to the lower electrode 16 and the upper electrode 18, and current is sent between two electrodes. And the bottom container 14 and the lid 17 are installed in the sliding direction (vertical mold). It may be made to apply agarose to the upper part and the surface of the lower electrodes 18 and 16. The influence of the cell on the chemical reaction near the electrode surface is mitigable by applying agarose to an electrode surface.

[0017] The numerals 20 are the members for culture of a cylindrical shape provided with the centrum 21 which has the predetermined capacity for accommodating the culture medium which put in the cell which it is fitted in the container 14 and is mostly cultured in the center. The centrum 21 stores the upper electrode 18 of the lid 17 in the center mostly. The member 20 for culture equips the upper surface with a pair of hole 22, in order to make easy extraction of this part 20 that fitted into the container 14, as shown in drawing 3. It can remove easily by putting tweezers into the hole 22 and inserting the pars intermedia material 20 with tweezers in this way. The numerals 23 are the projections for gaps for preventing desiccation of a culture medium. The numerals 24 are culture media.

[0018] And the filter 25 for preventing it from the cell into which it was put by the culture medium 24 of the centrum 21 of the member 20 for culture between the member 20 for culture and the container 14 falling to the lower electrode 16 of the container 14, and contacting this electrode 16 is allocated. The filter 25 consists of a penetrable membrane film, and the aperture is 8 microns in 0.4 and thickness. The crevice between the member 20 for culture and the container 14 is set as about 0.2 mm or less so that the culture medium 24 into which it was put by the centrum 21 of the member 20 for culture may not overflow besides the culture member 20.

[0019] When you need many amounts of culture media, as it is shown in drawing 4, when enlarging the cross sectional area A of the centrum 21 of the member 20 for culture, enlarging capacity and, lessening the amount of culture media on the other hand, as shown in drawing 5, The cross sectional area B of the centrum 21 of the member 20 for culture ($A > B$) is made small, and capacity is made small. The amount of culture media can be easily changed only by exchange of the member 20 for culture by preparing two or more members 20 for culture from which the cross sectional area of the centrum 21 differs in this way. Therefore, even if the amount of culture media changes with kinds of cell to culture, it can respond promptly

and easily. Only by exchanging the member 20 for culture, it can respond to several sorts of amounts of culture media, such as 1 ml and 3 ml.

[0020]The culture medium 24 is beforehand put into the hollow 15 of the container 14, and the penetrable membrane filter 25 is allocated between the container 14 and the member 20 for culture. Then, the culture medium 24 having contained the cell to culture is put in in proper quantity to the position in which the upper electrode 18 is immersed, predetermined voltage is impressed between the upper electrode 18 and the lower electrode 16, and current is sent. The current density in the culture medium 24 is called for by $\frac{I}{S}$ (ing) the passed current value with the cross sectional area of the centrum 21 of the member 20 for culture. And by making into a sliding direction the direction into which current flows, current density in the culture medium 24 can be made uniform, and, therefore, uniform current density can be given to a cell. The current density in the culture medium 24 can be made to change by making a current value regularly by preparing two or more members 20 for culture, and changing a cross-section area.

[0021]In order to culture a cell, predetermined voltage is impressed between the lower electrode 16 and the upper electrode 18, between two electrodes, to a cell, it is made to flow through current from a sliding direction, and current density uniform into this cell is given.

[0022]Drawing 6 shows other embodiments of a cell culture device. In this cell culture device, the numerals 26 are culture vessels which accommodate the culture medium 24 for culturing a cell. The container 26 is a container of the internal hollow which carried out cylindrical shape. the container 24 -- a pars basilaris ossis occipitalis -- it has the hollow 15 in the center mostly, and the lower electrode 16 is allocated in the hollow 15. The lid 17 is put on the container 26 from the upper part. The lid 17 equips with the upper electrode 18 the position which countered the lower electrode 16. The upper part and the lower electrodes 18 and 16 are spiral platinum electrodes, and the two electrodes 18 and 16 are connected to a current source (not shown) via the contact button 19, respectively. In this way, predetermined voltage is impressed to the lower electrode 16 and the upper electrode 18, and current is sent between two electrodes.

[0023]And the culture vessel 26 and the lid 17 are installed in the sliding direction (vertical mold). The inside of the container 26 for culture is provided with the following.

The filter 27 which uses penetrable collagen membrane.

The control member 28 which prevents the relief of the filter 27.

In this way, the filter 27 prevents the cell in the culture medium 24 from falling to the lower electrode 16. The filter 27 is allocated between the bottom container 26 and the control member 28, and coming floating by the culture medium 24 into which it was put by the container 26 is prevented. The current density in the culture medium 24 is called for by $\frac{I}{S}$ (ing) the passed current value with the cross sectional area of the filter 27 which consists of penetrable collagen membrane. When a current value is constant, current density can be changed and given to this cell by changing the cross sectional area of the filter 27 which consists of penetrable collagen membrane.

[0024]In order to culture a cell, predetermined voltage is impressed between the lower electrode 16 and the upper electrode 18, between two electrodes, to a cell, it is made to flow through current from a sliding direction, and current density uniform into this cell is given. This cell culture device and this cell culture method are used suitably for especially a cell culture experiment.

[0025]

[Effect of the Invention]According to the cell culture device and cell culture method concerning this invention,

current density can be made uniform and a cell can be made to culture without variation by passing direction of current to the upper and lower sides (vertical mold).

[Translation done.]

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CLAIMS

[Claim(s)]

[Claim 1]A container which has the predetermined capacity which installs a lower electrode in a pars basilaris ossis occipitalis; Cover from the upper part of said container and said container is sealed, And a lid which is provided with an upper electrode which countered said lower electrode and was allocated, counters said container and a sliding direction, and is arranged; It is fitted in into said container, And a member for culture mostly provided with a centrum which has the capacity which consists of a predetermined cross sectional area in the center; between said container and said member for culture. An allocated filter; a cell culture device provided with an electric power unit for impressing predetermined voltage to said lower electrode and said upper electrode, and sending current between two electrodes, and;.

[Claim 2]A container for culture which has the predetermined capacity which installs a lower electrode in a pars basilaris ossis occipitalis; Cover from the upper part of said container for culture, and said container is sealed, And it has an upper electrode which countered said lower electrode and was allocated, A control member which it comes to allocate by fixing to a lid and the; aforementioned container which counter said bottom container and a sliding direction and are arranged; between said container and said control member. A filter which has the allocated predetermined cross sectional area; a cell culture device provided with an electric power unit for impressing predetermined voltage to said lower electrode and said upper electrode, and sending current between two electrodes, and;.

[Claim 3]It is a cell culture device for impressing predetermined voltage between a lower electrode and an upper electrode, sending current between two electrodes, and making a cell in a culture medium culture, A cell culture device provided with a current density creating means which makes a sliding direction a direction into which current flows, makes current density in a culture medium uniform, and gives uniform current density to a cell.

[Claim 4]The cell culture device according to claim 1, wherein said lower electrode is allocated in a hollow established in a pars basilaris ossis occipitalis of said container.

[Claim 5]The cell culture device according to claim 1 to 3, wherein said upper part and a lower electrode are made from spiral platinum.

[Claim 6]The cell culture device according to claim 1 to 3 which applies agarose to the surface on which said upper part and a lower electrode counter, and is characterized by things.

[Claim 7]The cell culture device according to claim 1 or 2, wherein said filter is a penetrable membrane film or penetrable collagen membrane.

[Claim 8]The cell culture device according to claim 1, wherein said member for culture is provided with a pair of hole for putting in tweezers for attachment and detachment.

[Claim 9]A cell culture method impressing predetermined voltage between a lower electrode and an upper electrode, making into a sliding direction a direction which is a cell culture method for sending current and making a cell in a culture medium culture, and through which current flows between two electrodes, making current density in a culture medium uniform, and giving current density uniformly to a cell.

[Claim 10]A cell culture method impressing predetermined voltage between a lower electrode and an upper electrode, making into a sliding direction a direction which is a cell culture method for sending current and making a cell in a culture medium culture, and through which current flows between two electrodes, making current density in a culture medium variable, and changing and giving current density to a cell.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a global placement figure showing the cell culture device concerning this invention.

[Drawing 2]It is a schematic diagram showing the cell culture device concerning this invention.

[Drawing 3]It is a schematic diagram showing the member for culture of the cell culture device concerning this invention.

[Drawing 4]It is a sectional view showing the member for culture of the cell culture device concerning this invention.

[Drawing 5]It is a sectional view showing other members for culture of the cell culture device concerning this invention.

[Drawing 6]It is a schematic diagram showing other cell culture devices concerning this invention.

[Drawing 7]It is a schematic diagram showing the conventional horizontal-type cell culture device.

[Drawing 8]It is a schematic diagram showing other conventional cell culture devices.

[Description of Notations]

- 1 Function generator
- 2 Amplifier
- 3 Ammeter
- 4 Cultivation tank
- 5 Agarose
- 6 Contact button
- 7 Oscilloscope
- 8 Current source
- 9 Platinum electrode
- 10 Insulating material
- 11 Current regulator
- 12 Cell culture device group
- 13 Cell culture device
- 14 Container
- 15 Hollow
- 16 Lower electrode
- 17 Lid

- 18 Upper electrode
- 19 Contact button
- 20 Culture member
- 21 Centrum
- 22 Hole
- 23 The projection for gaps
- 24 Culture medium
- 25 and 27 Filter
- 26 Culture vessel
- 28 Control member

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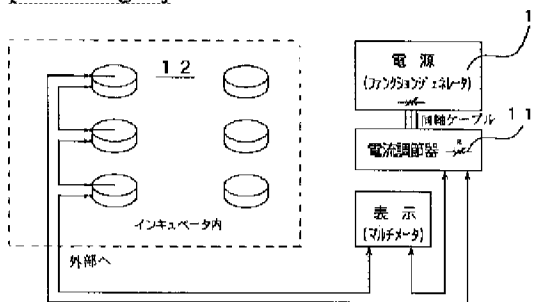
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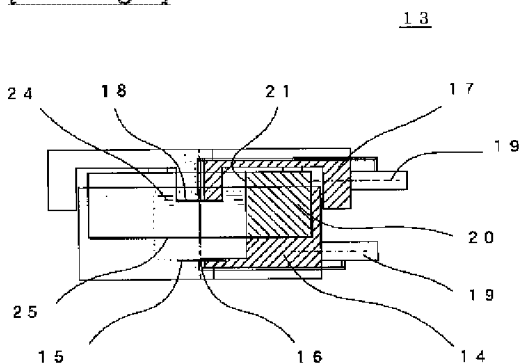
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DRAWINGS

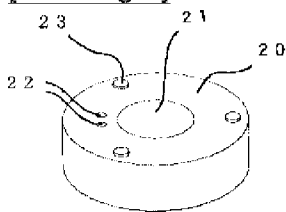
[Drawing 1]



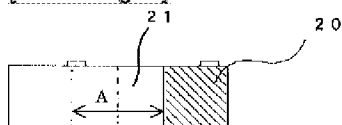
[Drawing 2]



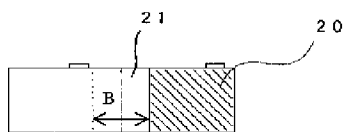
[Drawing 3]



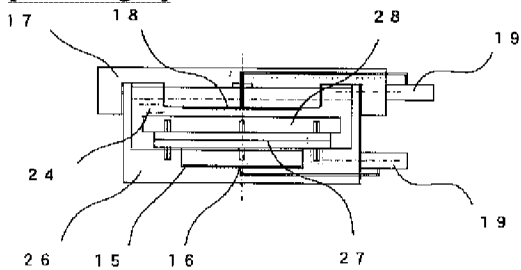
[Drawing 4]



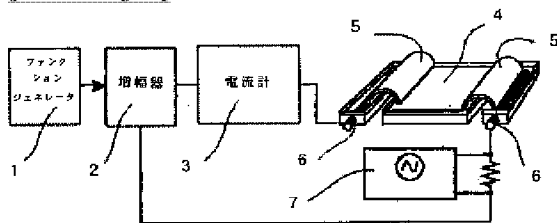
[Drawing 5]



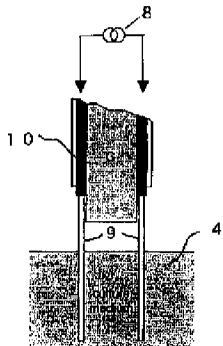
[Drawing 6]



[Drawing 7]



[Drawing 8]



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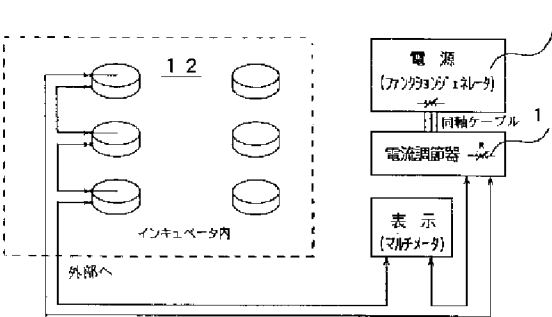
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(54)【発明の名称】 細胞培養装置及び細胞培養方法

(57)【要約】

【課題】 電流密度を均一にして細胞をバラツキなく培養させることができる細胞培養装置及び細胞培養方法を提供する。

【解決手段】 底部に下部電極16を設置してなる所定の容積を有する容器14と、容器14の上方から被せて容器14を密封し、かつ下部電極16に対向して配設した上部電極18を備え、容器14と上下方向に対向して配置される蓋体17と、容器14内に嵌挿され、かつほぼ中央に所定の横断面積からなる容積を有する中空部21を備える培養用部材20と、容器14と培養用部材20との間に配設されたフィルタ25と、下部電極16及び上部電極18に所定の電圧を印加して両電極間に電流を流すための電源装置とを備える。



【特許請求の範囲】

【請求項1】 底部に下部電極を設置してなる所定の容積を有する容器と；前記容器の上方から被せて前記容器を密封し、かつ前記下部電極に対向して配設した上部電極を備え、前記容器と上下方向に対向して配置される蓋体と；前記容器内に嵌挿され、かつほぼ中央に所定の横断面積からなる容積を有する中空部を備える培養用部材と；前記容器と前記培養用部材との間に配設されたフィルタと；前記下部電極及び前記上部電極に所定の電圧を印加して両電極間に電流を流すための電源装置と；を備えたことを特徴とする細胞培養装置。

【請求項2】 底部に下部電極を設置してなる所定の容積を有する培養用容器と；前記培養用容器の上方から被せて前記容器を密封し、かつ前記下部電極に対向して配設した上部電極を備え、前記下側容器と上下方向に対向して配置される蓋体と；前記容器に固定して配設される所定の横断面積を有するフィルタと；前記下部電極及び前記上部電極に所定の電圧を印加して両電極間に電流を流すための電源装置と；を備えたことを特徴とする細胞培養装置。

【請求項3】 下部電極と上部電極との間に所定の電圧を印加して両電極間に電流を流して培地内の細胞を培養させるための細胞培養装置であって、電流の流れる方向を上下方向にして培地内の電流密度を均一にし、細胞に均一な電流密度を与える電流密度生成手段を備えたことを特徴とする細胞培養装置。

【請求項4】 前記下部電極は、前記容器の底部に設けられた凹所内に配設されることを特徴とする請求項1記載の細胞培養装置。

【請求項5】 前記上部及び下部電極は渦巻き状の白金から作られることを特徴とする請求項1乃至3記載の細胞培養装置。

【請求項6】 前記上部及び下部電極の対向する表面にアガロースを塗布してなることを特徴とする請求項1乃至3記載の細胞培養装置。

【請求項7】 前記フィルタは、透過性メンブレイン膜又は透過性コラーゲン膜であることを特徴とする請求項1又は2記載の細胞培養装置。

【請求項8】 前記培養用部材は、着脱のためのピンセットを入れるための対の孔を備えることを特徴とする請求項1記載の細胞培養装置。

【請求項9】 下部電極と上部電極との間に所定の電圧を印加して両電極間に電流を流して培地内の細胞を培養させるための細胞培養方法であって、電流の流れる方向を上下方向にして培地内の電流密度を均一にし、細胞に均一に電流密度を与えることを特徴とする細胞培養方法。

【請求項10】 下部電極と上部電極との間に所定の電圧を印加して両電極間に電流を流して培地内の細胞を培

養させるための細胞培養方法であって、電流の流れる方向を上下方向にして培地内の電流密度を可変にし、細胞に電流密度を可変して与えることを特徴とする細胞培養方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、培地内の細胞を培養するための細胞培養装置及び細胞培養方法に関する。

【0002】

【従来の技術】図7は、従来の横型細胞培養装置の概略図である。図において、ファンクションジェネレータ1（関数発生器）の電流は増幅器2、電流計3を介して細胞培養装置内の両端に配設された電極の接続端子6に流れる。細胞培養装置は培養槽4の両側に直接に、若しくは汚染物質除去のためにアガロース5を介して電極間に電圧を印加することにより培養液内の細胞に電流を流す。そして、流れる電流値はオシロスコープ7にて求められる。図8は、他の細胞培養装置の概略図である。該図も同様に電流源8から絶縁物10で覆われた白金電極9に接続し、直接培地に差し込みに培地内の細胞に電流を流すものである。

【0003】

【発明が解決しようとする課題】従来の細胞培養装置は電流を左右、すなわち横方向に流すものであった。このため、電流密度を均一にしても浮遊細胞と吸着細胞とで、細胞の形状、培地の成分沈殿などの影響により、細胞への電流刺激に偏りがあった。また、電極表面近傍で化学反応により細胞の培養に影響を与えるためアガロースなどの緩衝剤を電極表面に付着させていた。さらに、培養する細胞の種類に応じて、あるいは細胞内物質の同定実験に対しては、使用する培地量を変化して対応するため、多種の培養皿が必要になるというような欠点を持っていた。

【0004】本発明は、上述した従来の欠点を解決するためになされたもので、その目的は電流の向きを上下（縦型）にすることにより電流密度を均一にして細胞をバラツキなく培養させることができる細胞培養装置及び細胞培養方法を提供することにある。

【0005】

【課題を解決するための手段】請求項1に係る細胞培養装置は、底部に下部電極を設置してなる所定の容積を有する容器と；前記容器の上方から被せて前記容器を密封し、かつ前記下部電極に対向して配設した上部電極を備え、前記容器と上下方向に対向して配置される蓋体と；前記容器内に嵌挿され、かつほぼ中央に所定の横断面積からなる容積を有する中空部を備える培養用部材と；前記容器と前記培養用部材との間に配設されたフィルタと；前記下部電極及び前記上部電極に所定の電圧を印加して両電極間に電流を流すための電源装置とを備える。

【0006】請求項2に係る細胞培養装置は、底部に下

部電極を設置してなる所定の容積を有する培養用容器と；前記培養用容器の上方から被せて前記容器を密封し、かつ前記下部電極に対向して配設した上部電極を備え、前記下側容器と上下方向に対向して配置される蓋体と；前記容器に固定して配設されてなる押え部材と；前記容器と前記押え部材との間に配設された所定の横断面積を有するフィルタと；前記下部電極及び前記上部電極に所定の電圧を印加して両電極間に電流を流すための電源装置とを備える。

【0007】請求項3に係る細胞培養装置は、下部電極と上部電極との間に所定の電圧を印加して両電極間に電流を流して培地内の細胞を培養させるための細胞培養装置であって、電流の流れる方向を上下方向にして培地内の電流密度を均一にし、細胞に均一な電流密度を与える電流密度生成手段を備える。

【0008】請求項4に係る細胞培養装置は、前記下部電極は、前記容器の底部に設けられた凹所内に配設されることを特徴とする。

【0009】請求項5に係る細胞培養装置は、前記上部及び下部電極は渦巻き状の白金から作られることを特徴とする。

【0010】請求項6に係る細胞培養装置は、前記上部及び下部電極の対向する表面にアガロスを塗布してなることを特徴とする。

【0011】請求項7に係る細胞培養装置は、前記フィルタは、透過性メンブレイン膜又は透過性コラーゲン膜であることを特徴とする。

【0012】請求項8に係る細胞培養装置は、前記培養用部材は、着脱のためのピンセットを入れるための対の孔を備えることを特徴とする。

【0013】請求項9に係る細胞培養方法は、下部電極と上部電極との間に所定の電圧を印加して両電極間に電流を流して培地内の細胞を培養させるための細胞培養方法であって、電流の流れる方向を上下方向にして培地内の電流密度を均一にし、細胞に均一に電流密度を与えることを特徴とする。

【0014】請求項10に係る細胞培養方法は、下部電極と上部電極との間に所定の電圧を印加して両電極間に電流を流して培地内の細胞を培養させるための細胞培養方法であって、電流の流れる方向を上下方向にして培地内の電流密度を可変にし、細胞に電流密度を可変して与えることを特徴とする。

【0015】

【発明の実施の形態】以下、本発明に係る細胞培養装置の実施の形態を添付図面を参照して詳述する。図1は細胞培養装置の概略配置図を示すものである。ファンクションジェネレータ1によって発生した信号波形を電流調節器11を介して電流源とし、これを細胞培養装置群12に直接続し、閉回路内に流れる電流を電流計により測定して表示する。

【0016】図2は細胞培養装置13の構造を示す概略図である。図に示された細胞培養装置において、符号14は、円筒形状をした内部中空の所定の容積を有する容器である。容器14は、底部のほぼ中央に凹所15を備え、凹所15内に下部電極16が配設されている。容器14には、上方より蓋体17が被せられる。蓋体17は、下部電極16に対向した位置に上部電極18を備える。上部及び下部電極18、16は、渦巻き状若しくは円板状白金電極からなる。両電極18、16は、それぞれ接続端子19を介して電流源（図示せず）に接続される。電極を渦巻き状にすることにより、その隙間から細胞の形態を観察することができる。かくして、下部電極16及び上部電極18に所定の電圧を印加して両電極間に電流を流す。そして、下側容器14と蓋体17とは、上下方向（縦型）に設置されている。上部及び下部電極18、16の表面にアガロスを塗布するようにしてもよい。電極表面にアガロスを塗布することにより電極表面近傍の化学反応の細胞への影響を軽減することができる。

【0017】符号20は、容器14に嵌挿され、かつほぼ中央に培養する細胞を入れた培地を収容するための所定の容積を有する中空部21を備える円筒形の培養用部材である。中空部21は、ほぼ中央で蓋体17の上部電極18を収納する。培養用部材20は、図3に示されるように、容器14に嵌合した該部20の取り出しを容易にするための対の孔22を上面に備える。かくして、ピンセットを孔22に入れ、ピンセットで中間部材20を挟むことにより容易に取り外すことができる。符号23は、培地の乾燥を防止するための間隙用突起である。符号24は、培地である。

【0018】そして、培養用部材20と容器14との間には培養用部材20の中空部21の培地24に入れられた細胞が、容器14の下部電極16に落下して該電極16に接触するのを防止するためのフィルタ25が配設される。フィルタ25は、透過性メンブレイン膜からなり、その孔径は0.4、厚さ8ミクロンである。培養用部材20と容器14との隙間は、培養用部材20の中空部21に入れられた培地24が培養部材20の外にあふれ出ないように約0.2mm以下に設定されている。

【0019】また、培地量を多く必要とする場合、図4に示されるように、培養用部材20の中空部21の横断面積Aを大きくして容積を大きくし、一方培地量を少なくする場合、図5に示されるように、培養用部材20の中空部21の横断面積B（A>B）を小さくし、容積を小さくする。かくして、中空部21の横断面積の異なる培養用部材20を複数個用意しておくことにより、培養用部材20の交換のみで簡単に培地量を変更することができる。よって培養する細胞の種類により培地量が異なっても迅速にかつ容易に対応することができる。培養用部材20を交換することのみで、1ml、3mlなど数

種の培地量に対応できる。

【0020】容器14の凹所15にあらかじめ培地24を入れ、そして容器14と培養用部材20との間に透過性メンブレンフィルタ25を配設する。その後、培養する細胞を含んだ培地24を上部電極18が浸る位置まで適量入れ、上部電極18と下部電極16との間に所定の電圧を印加して電流を流す。培地24内の電流密度は、流した電流値を培養用部材20の中空部21の横断面積で除することにより求められる。そして、電流の流れる方向を上下方向にすることにより培地24内の電流密度を均一にでき、よって細胞に均一の電流密度を与えることができる。さらに、培地24内の電流密度は、電流値を一定にすることにより、培養用部材20を複数個用意して断面積を可変することにより可変させることができる。

【0021】細胞を培養するには、下部電極16と上部電極18との間に所定の電圧を印加して両電極間に細胞に対して電流を上下方向から流れるようにし、かつ該細胞に均一の電流密度を与える。

【0022】図6は細胞培養装置の他の実施の形態を示す。該細胞培養装置において、符号26は、細胞を培養するための培地24を収容する培養容器である。容器26は、円筒形状をした内部中空の容器である。容器24は、底部のほぼ中央に凹所15を備え、凹所15内に下部電極16が配設されている。容器26には、上方から蓋体17が被せられる。蓋体17は、下部電極16に対向した位置に上部電極18を備える。上部及び下部電極18、16は、渦巻き状白金電極であり、両電極18、16は、それぞれ接続端子19を介して電流源（図示せず）に接続される。かくして、下部電極16及び上部電極18に所定の電圧を印加して両電極間に電流を流す。

【0023】そして、培養容器26と蓋体17とは、上下方向（縦型）に設置されている。培養用容器26の内部は、透過性コラーゲン膜を使用したフィルタ27と、フィルタ27の浮き上がりを防止する押え部材28とを備える。かくして、フィルタ27は、培地24内の細胞が下部電極16に落下するのを防止する。フィルタ27は、下側容器26と押え部材28との間に配設され、容器26に入れられた培地24により浮き上がることが防止される。培地24内の電流密度は、流した電流値を透過性コラーゲン膜からなるフィルタ27の横断面積で除することによって求められる。さらに、電流値が一定の場合、透過性コラーゲン膜からなるフィルタ27の横断面積を可変することにより該細胞に対して電流密度を可変して与えることができる。

【0024】細胞を培養するには、下部電極16と上部電極18との間に所定の電圧を印加して両電極間に細胞に対して電流を上下方向から流れるようにし、かつ該細胞に均一の電流密度を与える。なお、該細胞培養装置及び該細胞培養方法は、特に細胞培養実験に好適に使用さ

れる。

【0025】

【発明の効果】本発明に係る細胞培養装置及び細胞培養方法によれば、電流の向きを上下（縦型）に流すことにより電流密度を均一にして細胞をバラツキなく培養させることができる。

【図面の簡単な説明】

【図1】本発明に係る細胞培養装置を示す概略配置図である。

【図2】本発明に係る細胞培養装置を示す概略図である。

【図3】本発明に係る細胞培養装置の培養用部材を示す概略図である。

【図4】本発明に係る細胞培養装置の培養用部材を示す断面図である。

【図5】本発明に係る細胞培養装置の他の培養用部材を示す断面図である。

【図6】本発明に係る他の細胞培養装置を示す概略図である。

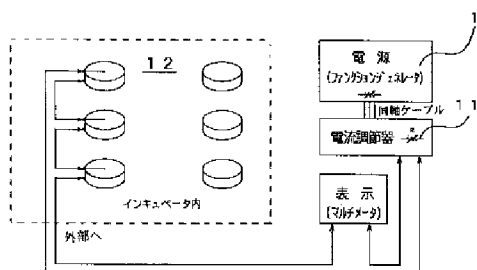
【図7】従来の横型細胞培養装置を示す概略図である。

【図8】従来の他の細胞培養装置を示す概略図である。

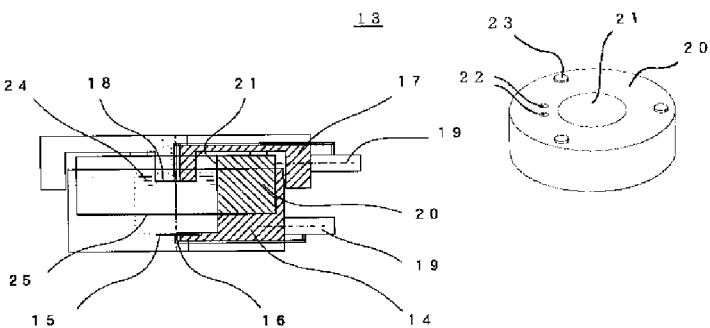
【符号の説明】

- 1 ファンクションジェネレータ
- 2 増幅器
- 3 電流計
- 4 培養槽
- 5 アガロース
- 6 接続端子
- 7 オシロスコープ
- 8 電流源
- 9 白金電極
- 10 絶縁物
- 11 電流調節器
- 12 細胞培養装置群
- 13 細胞培養装置
- 14 容器
- 15 凹所
- 16 下部電極
- 17 蓋体
- 18 上部電極
- 19 接続端子
- 20 培養部材
- 21 中空部
- 22 孔
- 23 間隙用突起
- 24 培地
- 25、27 フィルタ
- 26 培養容器
- 28 押え部材

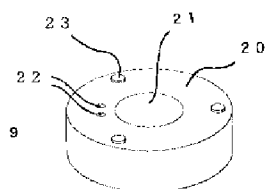
【図1】



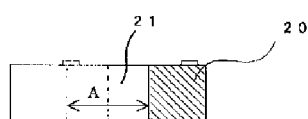
【図2】



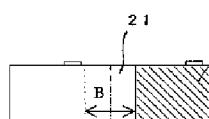
【図3】



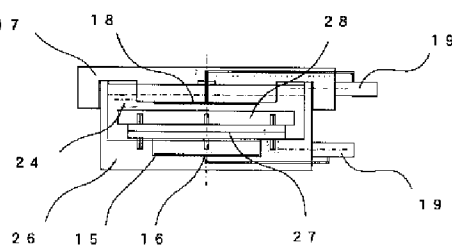
【図4】



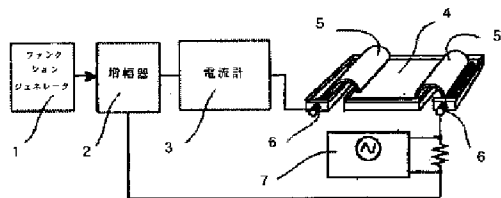
【図5】



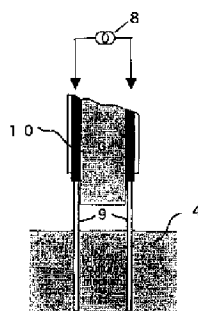
【図6】



【図7】



【図8】



フロントページの続き

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